

The Application of Borax (trade name Sporax®) to limit the Spread of Annosus Root Disease

AFFECTED ENVIRONMENT

To reduce the spread of Annosus root disease in the Sunny South Project Area borax (hydrated salt of boric acid – sodium tetraborate decahydrate) would be applied to freshly cut stumps of all conifer species 12” DBH or greater. Borax would be applied by hand to the freshly cut stump surfaces. Application rates will average 1 per 50 square feet of stump surface area. The following estimates were developed for the nearby Biggie Project Area and will serve as a good comparative estimate for the Sunny South Project Area. In the Biggie Project area there are approximately there are 39.5 stumps per acre ranging from 14-32” stump diameter. This will result in approximately 139662.7 square feet of stump surface area, resulting in an average application rate of 1.9 pounds of borax per acre 1470 acres. Safety and resource protection measures would include the following:

- The application of would comply with all applicable state and federal regulations for the safe use of pesticides, including the Sporax® label requirements, e.g., applicators will be adequately trained, medical aid will be available, wash water and eye wash water will be on site or nearby, and personal protective equipment will be used (eye protection, gloves, long-sleeved shirt, and long pants).
- Implement Best Management Practices (BMPs) for pesticide application, including a spill contingency plan.
- Do not apply Sporax® within 25 feet of live streams, or riparian vegetation, whichever distance is greater.
- Do not apply Sporax® during sustained rainfall.

Annosus root disease is caused by the fungus *Heterobasidion annosum*. It resides in the butts and roots of its host trees (Adams 2004) and is a common and natural disease of North American forests. Spore production can occur at any time of the year but the moist period of late fall is when the bulk of spores are produced. Both the asexual and sexual spores can colonize stumps, butt wounds, and roots. Once in the host tree, the disease can connect to other hosts through root contact. Airborne spores can travel many miles and infect trees very far away from the original site of spore production (Adams 2004). Fire suppression and selective cutting of pine species has created denser stands of true fir. The cooler temperatures under these fir stands have created favorable conditions that allow the Annosus root disease to take hold (Otrosina and Cobb 1989, Annessi, D’Amico and Motta 2005). True firs themselves are highly susceptible hosts (Slaughter and Parmeter 1989). These two current conditions have proved to be synergistic and exacerbated the problem of annosus root rot. This root disease weakens trees leading to increased susceptibility to bark beetle attack, or even death.

Sporax® (borax) is registered for forestry use as a conifer stump treatment to control annosus root disease. The target species is the fungus *Heterobasidion annosum*. Borax is a contact fungicide that inhibits the growth of fungi by preventing spore production

(Information Ventures, 2004). Several studies have demonstrated the efficacy of using borax as a stump treatment in California. Graham (1971) demonstrated the efficacy of borax on Jeffrey and ponderosa pine. Smith (1970) demonstrated that borax prevented infection of white fir stumps. Kliejunas (1989) provides a summary of the existing literature on borax effectiveness in the eastside pine type.

Borax as used in forestry is identical to the material sold throughout North America as a household cleaning agent and also used for control of household insects (Dost et al. et al., 1996, p. 1). Borax has even been recommended as a “safe alternative to common household products” (Mother Earth News 1990; Wilmington College 2003; AEHA 2005). These “environmentally friendly” household cleaning solutions are in much closer proximity to humans and probably in higher concentrations than tree stump applications.

ENVIRONMENTAL CONSEQUENCES

Borax would be applied to felled conifer stumps 14 inches or greater in stump diameter in the project area.

Effects to Soils

Dost et al. (1996, p. 6 and 7) reports that boron is almost ubiquitous in the earth’s crust, and is present in soil at low concentrations as a borate or related compound. Concentrations in soil are generally less than 10 parts per million (ppm), but in some cases as high as 200 ppm (Eisler, 1990).

Persistence/Mobility: Borax is adsorbed by the mineral portion of the soil, and remains unchanged in the soil for varying lengths of time, depending on soil acidity and rainfall. The average persistence is 1 year or more. Borax is less persistent in acid soils and in areas with high rainfall conditions, where borax may leach rapidly, but has a greater rate of adsorption and immobilization in soils with less organic content. (Information Ventures, 2004).

Dost et al. conducted a study to determine the distribution of boron in the environment before and after application of borax to freshly cut stumps. He found no increases in the boron content of adjacent foliage, litter and soil up to distance 5 meters from the center of the stumps after treatment. (Dost et al., 1996, p. 10 and 11, Dost et al., 1996, Appendix A).

At high rates, borax can act as a soil sterilant (USDA FS, 1995 Info. Vent, p. 4). Should a spill occur, the protocol for cleanup that is outlined in the Sunny South Area project spill plan will be followed.

Effects to Water Quality

Surface waters naturally contain low levels of boron at an average concentration from 0.001 mg/L to 0.1 mg/L (Information Ventures, 2004). Although borax is highly soluble in water (Eisler, 1990), it has a low potential for surface water contamination (USDA FS, 1995). Although no data has been obtained on movement of borax to water after stump treatment, movement into surface or groundwater is unlikely, since borax is adsorbed to mineral particles in the soil, and plant uptake would probably scavenge any boron

moving through soil (Dost et al., 1996). Dost et al. reports that although borates do not adsorb tightly to soils, attachment is such that only large amounts of rain or other water moving through the soil would be required to produce the leaching necessary to move boron to a water body (Burns and Collier, 1980). Dost et al. suggests that the absence of detectable boron taken up by adjacent plant after stump treatment, supports his conclusion that the migration of boron away from the site into water sources and aquatic flora and fauna at some distance from the site unlikely (Dost et al., 1996, p. 11).

The Sunny South Area receives precipitation primarily in the form of rain/snow. Though intense thundershowers can occur in the summer, generally thundershowers are not of an intensity that would move borax off of cut stumps and into a water body.

Project design features have been incorporated into the project design that would minimize the potential for borax to enter stream courses, would ensure the attainment of the Central Valley Water Quality Control Board water quality standards, and would not adversely affect soil productivity. Of particular importance are the 25 foot no treatment buffers along live streams, hand application methods and spill contingency planning. Dost et al. states that even if a significant spill were to occur, it is unlikely that measured amounts in water would be above background, natural levels of boron in water (Dost et al., 1996).

Risk to Workers and Forest Users

Evidence indicates that workers who apply borax to cut stumps are not at risk of adverse effects due to boron exposure (Dost et al., 1996 p. 61). Boron is excreted very rapidly without change by humans and other species, regardless of the route of intake (Dost et al., 1996 p. 57). Dost et al. concludes that due to the limited routes of borax exposure to forestry workers and forest users, coupled very little absorption through the skin any doses incurred are expected to be inconsequential to human health and safety (Dost et al., 1996 p.59). The proposed action requires strict adherence to applicable state, federal laws regarding safe use of pesticides and to the Sporax label requirements, i.e., proper worker training, use of required personal protective equipment, washing hands after handling and before eating, spill contingency planning, etc. These measures provide additional assurance that workers or forest users would not be exposed to hazardous levels of borax through dermal contact, ingestion or inhalation. The Sporax® formulation is exempt from the Worker Protection Standard because it is applied to a harvested portion which is not used for food feed or fiber.

The recently completed *Human Health and Ecological Risk Assessment for Borax (Sporax®) Final Report* (SERA, 2006) determined that none of the exposure scenarios considered for workers and the public in general yielded hazard quotients that exceed the level of concern. The exception was the scenario for a child that consumes Sporax applied to a tree stump. However, based on the highest exposure value modeled for this scenario, the estimated exposure to a child ingesting applied Sporax is less than the lowest reported lethal dose in children by factors of about 11 to 135. The actual risk of such an incident of ingestion by a child of Sporax applied to a stump as part of the Sunny South Project is extremely low. Thus, based on this analysis (SERA, 2006) there is no basis for asserting that systemic toxic effects to workers or the general public will result from either acute or longer-term exposures, except by direct consumption. Borax can cause eye irritation.

Quantitative risk assessments for irritation are not derived; however, from a practical perspective, eye irritation is likely to be the only overt effect as a consequence of mishandling Sporax. This effect can be minimized or avoided by prudent industrial hygiene practices during the handling of the compound. (SERA, 2006).

Effects to Wildlife

Based on existing data Dost et al. concludes that adverse effects on wildlife from stump treatment with borax are improbable (Dost et al., 1996 p.61). Proposed use of borax in the Sunny South Project Area is not expected to adversely impact wildlife for the following reasons:

- Routes and duration of exposure would not result in acute or chronic toxic effects to wildlife, particularly since wildlife is not attracted to borax,
- Borax does not bioaccumulate.
- Though adverse impacts to individuals could occur, under an unlikely exposure e.g. a spill, populations would not be affected. Project design features including spill contingency planning; treatment of cut stumps only, i.e. not vegetation, soil, or litter; low use rates; etc. are expected to minimize the risk to wildlife.

For terrestrial species, risk associated with the application of Sporax to tree stumps appears to be very low. Most risk quotients are below the level of risk by factors of about 200 to over 33,000. Since borax is used effectively in the control of fungi and insects, adverse effects of environmental exposures to non-target insects and microorganisms are possible. However, given the atypical application method for Sporax, widespread exposures are not likely. (SERA, 2006).

Effects to Plants

Boron is an essential nutrient for plants, and boron compounds, including borax occur widely in nature. Boron is taken up from soil by plants in proportion to the amount of boron in the soil. Borax is used in fertilizer formulations to supply boron. However, borax at high levels may kill plants, and may be used as a nonselective herbicide (Information Ventures, 2004). Apparently the difference in doses between boron's effectiveness as a nutrient and its effect as an herbicide are not very distinct, and vary from species to species. Agricultural use of boron as a foliar fertilizer or fungicide generally occurs in the range of 0.9 to 9 lbs/acre (borax equivalent) while as a soil fertilizer, borax would be applied at a rate of 9 to 18 lbs/acre (Travis et al 2003, US Borax 2005). Above an application rate of 20 pounds borax per acre, there are indications that borax would act as an herbicide (27 pounds per acre is recommended as a control of creeping Charlie (*Glechoma hederacea*) in turf grass in the Midwest (Lunsford 1998)). Applied at very high rates (670 to 1,770 pounds borax per acre) it will act as a soil sterilant (WSSA 2002, US EPA 1993, Kimball et al 1956). US EPA (1993) states that borax can be applied to treat Klamath weed at a rate of 3-4 pounds/100 square feet (equivalent to 1,300 to 1,700 pounds/acre).

The average application of borax in Region 5 is 1 pound per acre while the heaviest application reported over the last five years was at 6 pounds per acre; 90% of the

applications are at or below 2.5 pounds per acre. Admittedly there is little information on the levels of borax that result in negative plant effects, however, these rates of application are within the range used and recommended as foliar fertilizer applications on various agricultural crops and a factor of 10 times lower than recommended as a selective herbicide on turf grass. If Sporax was applied to foliage or the soil at the same rates as it is applied on the cut stump (1 pound/50 square feet), it would be applied in the range that would act as a soil sterilant (870 pounds per acre). The careful application onto the stump surface and the prompt cleanup of spillage is necessary to avoid effects to vegetation in close proximity to stumps. Again, Dost et al. found through limited monitoring data that no treatment-related increases in boron content of adjacent foliage, litter, or soil resulted from stump treatment. Because of the proposed application method and use rates, spill contingency planning, etc. plants are not expected to be routinely exposed to Sporax or at risk.

Application of Sporax in the Sunny South Project Area won't likely affect individuals and is unlikely to lead to a trend toward federal listing or loss of viability for Sensitive plant species.

Effects to Noxious Weeds

Application of Sporax is highly unlikely to cause disturbance which could encourage the spread of noxious weeds. An accidental spill may create potential habitat disturbance for noxious weeds by killing native vegetation, or could have a beneficial fertilizing effect depending on the amount spilled. However, the careful application onto the stump surface and the prompt cleanup of spillage, as directed in the project spill plan would likely avoid effects to vegetation in close proximity to stumps.

Effects to Aquatic Species

Application of borax to cut stumps is not expected to result in adverse effects to aquatic species, due to the low toxicity of borax to aquatic animals, and the low potential for borax to leach or enter surface water (Information Ventures, 2004, p. 3). As discussed under the risks to water quality, mitigation measures incorporated into the project design provide additional assurance that the potential for adverse impacts to aquatic species would be very low. There is a possibility that an amphibian on land can be exposed to borax outside the 25 foot buffer, which could lead to adverse impacts. Though an individual may be affected, effects to populations would not be expected.

For Aquatic animals and plants, hazard quotients marginally exceed the level of concern for amphibians for the worst-case accident spill of 25 pounds of Sporax into a small pond, and for the sensitive species of microorganisms for all accidental spill scenarios. None of the other exposure scenarios results in hazard quotients that exceed the level of concern in any aquatic species. This results indicate that aquatic animals and plants are not at a risk under the exposure scenarios considered; however, and accidental spill of large quantities of Sporax into a pond may result in toxicity in amphibians and sensitive species of aquatic microorganisms. Such an accidental spill into a pond during the application of Sporax as would be applied during the Sunny South Area Project is highly unlikely.

Effect to Invertebrates or Microorganisms

Based on available research data or examination of potential maximum distribution in the environment surrounding treated stumps, use of borax for stump treatment should be expected to have no effect on invertebrates or microorganisms in the Sunny South Project Areas. Though individuals could be affected in the event of a spill, or if individuals land on treated stumps and are exposed to large doses, when considered on the basis of landscape and populations, no detectable effects would be expected (Dost et al., 1996 p. 61-62).

Cumulative Effects

The Sunny South Project Area project would be implemented over approximately the next 5 years. Cumulative impacts from borax treatment of cut stumps are not expected within the project area, as borax generally dissipates within one year or less of application. Any past actions that involved the application of borax to cut stumps would have been implemented at an intensity similar to what is being proposed by this project and any potential effects would have not have carried forward to the present. Any future Forest Service projects would likely apply borax at similar intensities as proposed by the Sunny South Project Area. Potential effects associated with borax application from current or future timber harvest activities on private land is expected to be none to insignificant since borax is not commonly used by private land owners in this area. Region 5 policies requires borax treatment of cut stumps in recreational sites such as campgrounds to prevent potential spread of annosus root disease to residual, highly valued trees. All these foreseeable future actions are not expected to result in any cumulative effects any different from those described for the Sunny South Project Area.

Summary Conclusion – Borax Application

Available studies on borax indicate that borax is relatively benign to humans and the environment. Reports of adverse impacts from borax and related borate compounds occur only when exposures are much greater than would be expected under the Sunny South Project proposal. Proposed borax use rates and hand application to the surface of recently cut stumps are not expected to result in exposures that would cause adverse effects to humans or the environment. Project design features and management requirements provide additional assurance that proposed application of borax to cut stumps would have no adverse direct, indirect or cumulative impacts to human health and safety and the environment.